CLAIMS

1. A method of heat-treatment of materials, preferably metals, said method comprising the following steps:

- providing and maintaining a flame by supplying a burner with fuel and gas containing at least 80 percent by volume oxygen, wherein said gas is supplied at supersonic velocities;
- creating an oxygen and hot exhaust mixture by recirculating exhausts from said flame to said gas containing oxygen by means of an ejector effect;
- mixing said oxygen-exhaust mixture and said fuel; and
- providing a secondary recirculation by recirculating exhausts from said flame to said oxygen-exhaust-fuel mixture.

2. The method according to claim 1, wherein the step of providing and maintaining a flame comprises the step of injecting the gas containing oxygen in at least one nozzle to form a free jet to a distance of at least 15 nozzle diameters.

3. The method according to claim 1 or 2, wherein the step of creating an oxygen-exhaust mixture comprises mixing said gas containing oxygen with at least six times the gas volume of hot exhausts.

4. The method according to any of claims 1-3, wherein the step of creating an oxygen-exhaust mixture comprises mixing said gas containing oxygen and said hot exhaust over a distance of at least 20 nozzle diameters

by allowing the gas containing oxygen to impinge on walls of a mixing chamber.

5. The method according to any of claims 1-4, wherein the step of mixing said oxygen-exhaust mixture and said fuel comprises mixing at a velocity greater than Mach 0.5.

6. The method according to any of claims 1-5, comprising the additional step of effecting a heat exchange between exhausts leaving the process and the oxygen supplied to the burner.

7. The method according to any of claims 1-6, wherein the gas containing oxygen contains above 99.5% by volume oxygen.

8. The method according to any of claims 1-7, wherein the gas containing oxygen contains less than 4.5% by volume argon.

9. The method according to any of claims 1-8, wherein the gas containing oxygen contains less than 5.5% by volume nitrogen.

10. The method according to any of claims 1-9, wherein the heat treatment includes heat treatment of steel.

11. An apparatus for heat-treatment of materials, preferably metals, comprising:

- at least one fuel nozzle (16a) connectable to a fuel source;

- at least one gas nozzle (18a) connectable to a source of gas containing at least 80 percent by volume oxygen;

- wherein said at least one fuel nozzle and said at least one gas nozzle are arranged so at so provide a reaction zone (26);

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- means for supplying gas containing oxygen at supersonic velocities,

- means (24) for supplying hot exhausts from said flame upstream of said at least one gas nozzle to gas leaving said at least one gas nozzle by means of an ejector effect, thereby creating a oxygen-exhaust mixture, wherein said at least one fuel nozzle (16a) is provided downstream of said at least one gas nozzle (18a), and

- a flame tube (22) arranged around said gas nozzles, wherein the flame tube is provided with openings (24) arranged outside of a respective of said at least one gas nozzle (18a).

12. The apparatus according to claim 11, comprising means for injecting the gas containing oxygen to form a free jet to a distance of at least 15 nozzle diameters.

13. The apparatus according to claim 11 or 12, comprising means for mixing said gas containing oxygen and said hot exhaust over a distance of at least 20 nozzle diameters by allowing the gas containing oxygen to impinge on walls of a mixing chamber.

14. The apparatus according to any of claims 11-13, comprising means for mixing said oxygen-exhaust mixture and said fuel at a velocity greater than Mach 0.5.

15. The apparatus according to any of claims 11-14, wherein said at least one fuel nozzle (16a) is centrally provided in the apparatus.

16. The apparatus according to any of claims 11-15, wherein said at least one gas nozzle comprises at least two, more preferably four or six equidistant nozzles (18a) provided at a constant distance from a centre axis of the apparatus.

17. The apparatus according to any of claims 11-16, wherein said at least one gas nozzle (18a) is Laval shaped and/or aerodynamic.

18. The apparatus according to any of claims 11-17, wherein said at least one fuel nozzle (16a) is streamlined so as to allow for flameless combustion.

19. The apparatus according to any of claims 11-18, comprising a tube (22) provided in front of the gas and fuel nozzles (16a, 18a), wherein the tube (30) comprises an outer cylindrical tube (32) having a first open end facing the gas and fuel nozzles and a second closed end opposite of the first end, and an inner tube (34) provided in the outer tube (32) and having a diameter less than the inner diameter of the outer tube (32) so as to create an inner, essentially circular channel (36) and an outer, annular channel (38).

20. The apparatus according to claim 19, wherein the inner tube is positioned with its first end ending a

distance (L3) from a front end of the flame tube (22) and with its second end ending spaced apart from the closed end wall of the outer tube (32), thereby providing a secondary recirculation path for exhausts.

21. The apparatus according to claim 19 or 20, wherein said tube (22) has a cross-sectional area of more than 100 times the cross-sectional area of said at least one gas nozzle (18a).